THE UTILITY OF INCOME AND WEALTH

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"The notion of the utility of money, and other commodities, has long existed in economics."

"Utility can be viewed as a private money that allows for internal bookkeeping."

Duncan Luce, Individual Choice Behavior, 1959.

Within the field of economics, there is a longstanding controversy whether this private and internal bookkeeping is universal and consistent enough to reach general, practical and quantitative conclusions. If the answer is no, we can stop right here. But if the answer is yes, we may be able to supply objective, empirical and quantitative guidance for policies intended to increase the general welfare.

Those who choose to answer NO point to the difficulty of demonstrating interpersonal comparisons of utility. This objection universally relies on theoretical and not empirical arguments. The physicist Victor J. Stenger has written, "The only criterion for the scientific merit of a theory is that it provide a useful, economical description of our observations about the real world." Looking at the question this way we may be able to answer YES.

THE UTILITY OF INCOME

"Don't forget that the goal for engineers, scientists, and applied mathematicians is the calculation of an answer. If you can't do the final calculation you've failed, no matter how pretty your preliminary analysis may be." Paul J. Nahin, Duelling and Other Probability Puzzles (Princeton, 2000).

I propose a discrete, empirical and quantitative income utility function based on real-world experience. Traditional attempts to define an income utility function for individuals have generally postulated a continuous function. This is not a natural, empirical approach. We all know that our income is not continuous and does not arrive in infinitely small increments. We know that our income comes to us in discrete packets such as $1,000 per month. Clearly, a new approach is needed, something related to our real-world experience.

Even on a discrete basis, few of us get our income on a daily basis. Some receive their income on a weekly or bi-weekly basis and some on a monthly basis. One thing that we all have in common, however, is that we compare ourselves to others on the basis of our annual income, we pay our income taxes on the basis of annual income, and economists make societal comparisons on the basis of annual incomes. There are plenty of reasons to settle on annual income as a metric for our discrete utility calculus.

Given that we want to use annual income as our metric, how do we begin? I propose that we define the amount of annual

income that has 100% utility. We can each list our usual and necessary expenses, the ones that we feel we must provide for if we want to have or maintain a reasonable life. For this purpose, we have to look to the lower 50% of Americans, those who depend upon income to fund their lives. I am excluding, for the moment, those who have sufficient wealth to fund their lifestyles. I will address the utility of wealth later.

One way to address how much income has 100% utility is by making a personal assessment. In my own case, when I tally up my necessary expenses monthly and multiply by twelve months, I get about $30,000 in 2022. Another approach can look at the many calls around the country to increase the minimum wage to $15 per hour to give everyone a living wage. What would this mean? Full-time, year-round work at $15 per hour would be 2080 hours X $15 per hour or $31,200. One can also look at empirical studies of the cost of basic needs, one can look at government and private income poverty guidelines, and one can institute new research and surveys to try to home in on the appropriate number. This is an empirical question and I won't try to answer it any more precisely. It is bound to be a fuzzy number. It may be a bit more or a bit less than $30,000 per year. But it clearly is in this vicinity. We will press on.

I will take $30,000 per year of income as the amount that holds 100% utility for anyone who depends on income alone to support their life. Those with wealth can always dip into their wealth to supplement their income. But, even for them, that

first $30,000 is essential, we can be sure, no matter where it comes from.

We have now defined an increment of annual income, an income packet if you like. We next want to answer the question: What is the utility of the second increment of $30,000 per year? In other words, what is the utility of an annual income of $60,000? Given that the first $30,000 has 100% utility, how much utility does the second $30,000 increment hold?

Traditional utility functions--mathematical formulas for computing total utility--are not only continuous in nature but usually quite complicated. We want a discrete function and we want a simple function. If a more complicated function is necessary, let empirical research make that determination. For our purposes, we want to keep it simple. I have settled on a simple exponential function: Each additional increment of $30,000 has a utility of 90% of the previous increment.

Discrete calculus provides a compact statement of the problem of total utility for any level of annual income and a closed form solution as well. Here, "a" = total income, "b" = the discount factor of 0.9, and "i" = the number of the increments of income from i=0 to n.

$$\sum_{i=k}^{n} ab^i = [\frac{a}{b-1}](b^{n+1} - b^k)$$

For the total utility of a $60,000 annual income, we have

$$\sum_0^1 30{,}000(0.9)^i = \frac{30{,}000\left(0.9^2-1\right)}{0.9-1} = \$57{,}000.$$

For annual incomes that are not simple multiples of $30,000 a close approximation of the answer is to divide income by 30,000. So, the exponent for an income of $66,000 would be 2.2 and the result is $62,067.

$$\sum_0^1 30{,}000(0.9)^i = \frac{30{,}000(0.9^{2.2}-1)}{0.9-1}$$

= $62,067.

A precise calculation would yield $61,860 (30,000 X 0.9^0 + 30,000 X 0.9^1 + 6,000 X 0.9^2). This is a difference of $207 or 0.3%. For practical purposes the answers are identical.

This exact solution is a bit more tedious than using the general formula and may not be worth the extra effort.

The utility of annual income can never rise above $300,000 ($30,000/0.1). Iterative analysis of the number of increments shows that this equates to a real income of about $3,000,000, consisting of 100 $30,000 increments of income.

THE IMPLICATIONS FOR GENERAL WELFARE AND SOCIAL UTILITY

If annual real income above $3,000,000 has zero utility, then any taxation of that excess income which is used to improve general welfare or is transferred to those with less income must increase social utility. In accord with the Pareto Rule no one loses utility and others gain utility and social utility must increase.

This analysis supports progressive income taxation and sets some numerical parameters. The taxing authorities need not tax away all of the zero-utility income dollars, but this analysis provides a quantitative limit for such taxation. Of course, as I have emphasized, the numbers we work with are fuzzy and one should not take them as absolute. Empirical research should guide policymakers in setting the proper parameters for taxation. These include the increment of 100% utility income which I have set at $30,000 and the discount factor for additional increments of income which I have set at 90%. These parameters will obviously change over time. The numerical values are not constant laws of nature. They are social values or statistical values that vary over time. But the basic structure of this solution to the utility value of annual income remains the same even as the parameters change.

THE UTILITY OF WEALTH

As for taxing wealth, one answer is to mathematically convert wealth into an annuity and treat it as annual income. The

formula for converting wealth or net worth (assets less debts) into an annual income is quite simple:

r/(1-(1+r)^-years times net worth

where r = the rate of annual growth of the value of the assets and years = the years over which the annuity runs.

Both the rate of growth and the years of the annuity period may be set by policymakers for tax and social purposes.

Taking as an example that i = 0.15 (15%) and annuity years = 15 and net worth = $20,000,000, then the annuity wealth income is 0.15/(1-1.15^-15) X $20,000,000 = $3,420,341. If this individual has a real annual income of $200,000 then the total income for tax purposes is $3,620,341. Since any real income over $3,000,000 has zero utility from our previous analysis, $620,341 may be taxed away for use in promoting the general welfare without anyone being harmed.

A **direct** approach to assessing the utility of wealth might be the following hypothesis along the lines of my utility of income hypothesis. Assume $100,000 as the level of wealth that has 100% utility and a discount factor of 80% for each additional increment of $100,000. The formula for $200,000 in wealth becomes:

$$\sum_0^1 200{,}000(0.8)^i = \frac{100{,}000\left(0.8^2-1\right)}{0.8-1} = \$180{,}000.$$

Under this hypothesis, the maximum utility in wealth is $500,000 ($100,000/0.2). The equivalent real dollars in wealth

that this represents is about 100 times $100,000 or $10,000,000. Any wealth over $10,000,000 could be taxed away and used for public benefit or distributed to those with less wealth, thereby increasing social utility.

CONCLUSION

As is evident, the approach taken here makes the final calculations and arrives at specific quantitative conclusions. This approach to calculating the utility of income and wealth represents an empirical hypothesis. It is subject to empirical research and testing and to the revision of the parameters if evidence warrants.